

We claim:

1. A small and high performance rare earth permanent magnet for micro applications characterized in that in a cylindrical or disc-like rare earth magnet with a hole forming an inner surface or a cylindrical or prismatic rare earth magnet with no hole, that is formed by applying mechanical processing such as cutting, drilling, and surface grinding or polishing to a block magnet material, the magnet has a surface to volume ratio of  $2 \text{ mm}^{-1}$  or more, a volume of  $100 \text{ mm}^3$  or less, and R metal (here, R denotes one kind or more kinds of rare earth elements selected from the group consisting of Y, Nd, Dy, Pr, Ho and Tb) is allowed to diffuse and permeate from a magnet surface to the inside of the magnet to a depth corresponding to a radius of a grain exposed on the outermost surface of the magnet or more and thereby improving the quality of a portion damaged and denatured by the processing so that the magnetic characteristic  $(BH)_{\text{max}} = 280 \text{ kJ/m}^3$  or more is obtained.

2. A small and high-performance rare earth permanent magnet as set forth in claim 1 characterized in that the magnet is an Nd-Fe-B system or Pr-Fe-B system magnet and the R metal is Dy or Tb.

3. A method of manufacturing a small and high performance rare earth permanent magnet set forth in claim 1 or 2 characterized in that a cylindrical or disc-like rare earth magnet with a hole forming an inner surface or a cylindrical or prismatic rare earth

magnet with no hole, that is formed by applying mechanical processing such as cutting, drilling, and surface grinding or polishing to a magnet block and has a damaged and denatured surface is supported in a depressurized tank , and an R metal (here, R denotes one  
5 kind or two or more kinds of rare earth elements selected from the group consisting of Y, Nd, Dy, Pr, Ho and Tb) or an alloy containing an R metal is vaporized or transformed into fine particles in the depressurized tank by physical means and is three-dimensionally blown onto the whole or part of the surface of the magnet and deposited  
10 there, the R metal is allowed to diffuse and permeate from the surface of the magnet to the inside of the magnet at a depth corresponding to a radius of a grain exposed on the outermost surface of the magnet or more, and thereby the quality of a portion damaged and denatured by the mechanical processing is improved.

15 4. A method of manufacturing a small and high performance rare earth permanent magnet as set forth in claim 3 characterized in that the diffusion and permeation are carried out as deposition is carried out.

20 5. A method of manufacturing a small and high performance rare earth permanent magnet as set forth in claim 3 or 4 characterized in that the physical means is a sputtering method in which a plurality of targets made of the R metal or an alloy containing the R metal are arranged on the circumference of the rare earth magnet and ion-bombarded so as to be transformed into fine particles, and  
25 thereby a film is formed on the surface of the rare earth magnet; or an ion plating method in which the R metal or an alloy containing

the R metal is melted and vaporized and the thereby generated particles are ionized and deposited as a film on the surface of the rare earth magnet.

6. A method of manufacturing a small and high performance  
5 rare earth permanent magnet as set forth in claim 5 characterized  
in that the sputtering is carried out with the rare earth magnet  
held so that it can be freely rotated or tumbled in the plasma  
space in the middle of targets that are oppositely disposed a  
predetermined distance apart, thereby making it possible for a  
10 uniform film to be deposited on the external surface of the magnet.

7. A method of manufacturing a small and high performance  
rare earth permanent magnet as set forth in claim 6 characterized  
in that an electrode wire is extended to the plasma space in the  
middle of the oppositely disposed targets, the electrode wire is  
15 inserted and held in the hole of a cylindrical or disc-like rare  
earth magnet with a hole forming an inner surface, and, with the  
magnet rotating with the electrode wire as a rotation shaft, R  
metal or alloy containing the R metal which has been transformed  
into fine particles is blown so as to deposit uniformly on the  
20 external surface of the magnet.

8. A method of manufacturing a small and high performance  
rare earth permanent magnet as set forth in claim 7 characterized  
in that the oppositely-disposed targets are ring-like targets  
disposed concentrically about the center axis of the cylindrical  
25 or disc-like magnet.